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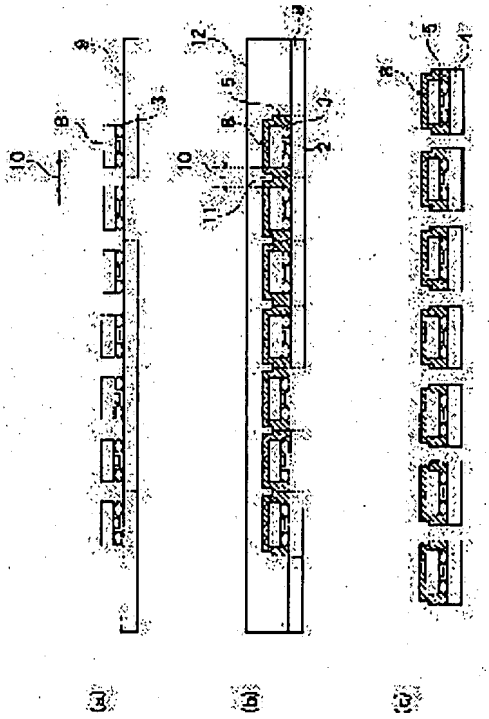
(54) SURFACE ACOUSTIC WAVE DEVICE AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a manufacturing method of a surface acoustic wave device which has resin sealed structure and has high reliability.

SOLUTION: Piezoelectric substrates surface acoustic wave elements having comb type tooth electrodes on the piezoelectric substrates are formed, the plurality of the surface acoustic wave elements are mounted on a multi-pieces base substrate between which bump electrodes are placed, resin is pushed on the surface acoustic wave elements using a die forming a projection part corresponding to a gap of the adjacent surface acoustic wave elements, the surface acoustic wave elements are sealed by the resin, and the resin and the base substrate is individualized for each surface acoustic wave element.



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* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is concerned with surface acoustic wave equipment and its manufacture approach, and relates to the dependability technique of surface acoustic wave equipment of having resin seal structure especially.
[0002]
[Description of the Prior Art] In recent years, surface acoustic wave equipment is broadly used as components, such as a filter in the electronic equipment which uses an electric wave, the delay line, and an oscillator. In fields, such as mobile communications, the miniaturization and high-reliability-izing of electronic equipment which are used are required, and there is the same demand also to surface acoustic wave equipment.
[0003] Surface acoustic wave equipment adopts FDB (face down bonding) structure and resin seal structure in order to reply to the demand of this miniaturization. That is, as shown in drawing 6 (a), many surface acoustic elements 58 by which the ctenidium electrode 52 was formed on the piezo-electric substrate are mounted on the base substrate 59 of picking through a bump 53. And two or more surface acoustic elements 58 are closed with resin 55 by pressing resin 55 against two or more surface acoustic elements 58 using metal mold 62. Two or more manufactures of the surface acoustic wave equipment which shows resin 55 and the base substrate 59 to drawing 6 (b) by piece[of an individual]-izing are carried out.
[0004] Here, since the field 63 of the metal mold 62 which pressurizes resin 55 is flat in case resin 55 is pressed against a surface acoustic element 58, the top face 64 of the resin 55 which touches this flat side 63 also turns into a flat side.
[0005]
[Problem(s) to be Solved by the Invention] However, as the arrow head of drawing 7 (a) shows, since two or more surface acoustic elements 58 set predetermined spacing mutually and are mounted, the pressures which join resin 55 will differ in the clearance 60 between a surface acoustic element 58 top and a surface acoustic element. In addition, the magnitude of an arrow head shows the magnitude of the pressure which joins resin 55. As shown in drawing 7 (b), even if it pressurizes resin 55 and sufficient time amount passes, although the big pressure has joined the resin 55 on a surface acoustic element 58 (chip top face), only a small pressure joins the resin 55 of the clearance 60 (in addition to this) between surface acoustic elements.
[0006] Consequently, resin 55 cannot fully enter the clearance 60 between surface acoustic elements, but a void 65 is formed between the base substrates 59, and the closure of the side face of a surface acoustic element 58 is not carried out. Therefore, this void 65 formation reduces the dependability of resin seal structure, as a result causes the problem of the dependability fall of surface acoustic wave equipment. Moreover, the problem of changing an intermediate frequency (fo) is also produced.
[0007] Accomplishing this invention in order to solve the technical problem of such a conventional technique, the purpose is offering the reliable surface acoustic wave equipment and its manufacture

approach of resin seal structure.
[0008]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the 1st description of this invention is surface acoustic wave equipment which has a base substrate, the projection electrode arranged on a base substrate, the surface acoustic element mounted on the base substrate through the projection electrode, the 1st resin section arranged on a surface acoustic element, and the 2nd resin section arranged on the base substrate of the perimeter of a surface acoustic element. Moreover, this surface acoustic wave equipment is characterized also by the top face of the 2nd resin section seeing from a base substrate and being lower than the top face of said 1st resin section.
[0009] The 2nd description of this invention forms two or more surface acoustic elements which have the ctenidium electrode arranged on a piezoelectric substrate and this piezoelectric substrate. A majority of two or more surface acoustic elements are mounted through a projection electrode on the base substrate of picking. It is the manufacture approach of the surface acoustic wave equipment which presses resin against two or more surface acoustic elements using the mold with which heights were formed corresponding to the clearance between the adjoining surface acoustic elements, closes two or more surface acoustic elements with resin, and piece[of an individual]-izes resin and a base substrate for every surface acoustic element.
[0010] According to the 1st and 2nd descriptions of this invention, a pressure joins homogeneity by pressing resin against two or more surface acoustic elements at the 2nd resin section formed on the 1st resin section formed on a surface acoustic element, and a base substrate using the mold with which heights were formed corresponding to the clearance between the adjoining surface acoustic elements. Thereby, it can prevent a void occurring on the side face of a surface acoustic element, and the dependability of the resin seal structure of surface acoustic wave equipment can be maintained and raised. As a result, the closure height on a surface acoustic element becomes higher than a part without a surface acoustic element. That is, rather than the top face of the 1st resin section, the top face of the 2nd resin section sees from a base substrate, and is set up low.
[0011] In the 1st description of this invention, when the difference of elevation seen from the base substrate of the top face of the 2nd resin section and the top face of the 1st resin section in the periphery of a base substrate is set to 1, as for the height seen from the base substrate of the top face of the 1st resin section, it is desirable that it is 10 thru/or 15. When the difference of elevation seen from the base substrate of the top face of the 2nd resin section and the top face of the 1st resin section in the periphery of a base substrate is more desirably set to 1, it is that the width of face of the 2nd resin section is 4 thru/or 20.
[0012] Moreover, as for the height of heights, in the 2nd description of this invention, it is desirable that it is 10 micrometers or more.
[0013]
[Embodiment of the Invention] With reference to a drawing, the gestalt of operation of this invention is explained below. In the publication of a drawing, the sign identically the same into a similar part or similar is attached. However, a drawing is typical and it should care about that the ratio of the relation between the thickness of a layer and width of face and the thickness of each class etc. differs from an actual thing. Moreover, of course, the part from which the relation and the ratio of a mutual dimension differ also in between drawings is contained.
[0014] Drawing 1 is the sectional view showing the configuration of the surface acoustic wave equipment concerning the gestalt of operation of this invention. Two or more projection electrodes 3 with which the surface acoustic wave equipment concerning the gestalt of operation has been arranged on the plate-like base substrate 4 and the base substrate 4, It has the surface acoustic element (1 2) mounted on the base substrate 4 through the projection electrode 3, 1st resin section 5a arranged on a surface acoustic element (1 2), and 2nd resin section 5b arranged on the base substrate 4 of the perimeter of a surface acoustic element (1 2). The top face 7 of 2nd resin section 5b sees from the base substrate 4 and is lower than the top face 6 of 1st resin section 5a.
[0015] 1st resin section 5a is arranged not only the upper chisel of a surface acoustic element (1 2) but

on the side face. 2nd resin section 5b is arranged on the base substrate 4 so that the perimeter of surface acoustic element (1 2) and 1st resin section 5a may be surrounded. That is, the resin seal of the surface acoustic element (1 2) is carried out by 1st resin section 5a and 2nd resin section 5b. Henceforth, in writing 1st resin section 5a and 2nd resin section 5b collectively, it only indicates it as the "resin section." The resin section has heights to the field to which the surface acoustic element (1 2) is arranged. In addition, about the shape of toothing of the resin section, it mentions later with reference to drawing 5 .

[0016] The resin section has the function to protect a surface acoustic element (1 2) from environmental stress and mechanical stress. As the resin section, for example, polyimide resin, a PP/EPR system polymer alloy (PP/Ethylene Propylene Rubber Blend), TEX (the Tonen Chemical, Inc. make, polyolefine system TPE (Polyolefine Thermoplastic Elastomer)), Tough PUREN (the Asahi Chemical Co., Ltd. make, SBS (Styrene-Butadiene-Styrene Block Copolymer)), MAKUSUROIA (Japan Synthetic Rubber Co., Ltd. make) and X-9 (the Unitika, Ltd. make --) Macromolecule system ingredients, such as PA/PAR (PA/Polyarylate) and TENAKKU (the Asahi Chemical Co., Ltd. make, POM/TPU (POM/Thermoplastic Polyurethane)), can be used.

[0017] Here, a surface acoustic element has the piezoelectric substrate 1 and a metal membrane pattern containing the ctenidium electrode 2 formed on the principal plane of the piezoelectric substrate 1. Although the ctenidium electrode 2 omits illustration, it is a metal electrode which has the flat-surface configuration of the shape of two or more ctenidium of gearing mutually. A surface acoustic wave (SAW) is excited and detected by the ctenidium electrode 2. An electrical signal is impressed to the input INTADEJITARU transducer of the ctenidium electrode 2, this is changed into a surface acoustic wave, and the piezo-electric substrate 1 top is made to transmit. The surface acoustic wave which furthermore reached the output INTADEJITARU transducer of another ctenidium electrode 2 is again changed into an electrical signal, and can be taken out outside. The metal used as the ingredient of the ctenidium electrode 2 consists of an alloy which uses aluminum (aluminum) or aluminum as a principal component. In the case of the latter, copper (Cu), silicon (Si), etc. can be used as an additive. In addition, the reflecting plate for reflecting the electrode pad connected to the projection electrode 3 other than the ctenidium electrode 2 and a surface acoustic wave is contained in a metal membrane pattern.

[0018] The electrical signal impressed to an input INTADEJITARU transducer and the electrical signal again transformed into the electrical signal by the output INTADEJITARU transducer are inputted from the base substrate 4 through the projection electrode 3, respectively, or is outputted to the base substrate 4. Although illustration was omitted, wiring connected mutually is formed also in the front rear face of the base substrate 4, and transmission and reception of an electrical signal are performed through this wiring. Moreover, the resin section is not arranged around the ctenidium electrode 2. This is for enabling it to perform normally excitation of the surface acoustic wave by the ctenidium electrode, detection, and the transfer on the piezo-electric substrate of a surface acoustic wave.

[0019] As a piezoelectric substrate 1, the single crystal substrate which consists of lithium tantalate ($LiTaO_3$), lithium niobate ($LiNbO_3$), a barium acid lithium substrate (LiB_4O_7), sapphire, or a quartz watch (SiO_2) can be used. Or it is also possible to replace with these single crystal substrates and to use the electrostrictive ceramics substrate which consists of lead titanate ($PbTiO_3$), titanic-acid lead zirconate ($PbZrTiO_3$ (PZT)), or these solid solutions.

[0020] Drawing 2 and each part Fig. of drawing 3 are main process sectional views to show the manufacture approach of the surface acoustic wave equipment shown in drawing 1 .

[0021] (b) Manufacture two or more surface acoustic elements to coincidence first using the piezoelectric wafer-like substrate 1. As shown in drawing 2 (a), specifically, the metal membrane of about 100nm of thickness numbers is formed on the piezo-electric substrate 1. The resist film is formed on this metal membrane, and the register film is exposed and developed by the phot lithography method. and this resist film -- a mask -- carrying out -- a metal membrane -- reactive ion etching (RIE) -- it etches alternatively by law and the metal pattern containing the ctenidium electrode 2 is formed. membrane formation of a metal membrane -- metal vacuum deposition, the sputtering method, and chemical vapor growth (CVD) -- law etc. can be used.

[0022] (b) Next, as shown in drawing 2 (b), form the projection electrode 3 on the electrode pad of a metal membrane pattern. Here, any of a golden bump or the solder bump of a SnPb system may be used as a projection electrode 3. The projection electrode 3 is formed in a position using bump bonder equipment.
[0023] (c) next, it is shown in drawing 2 (c) -- as -- dicing equipment -- using -- the piezoelectric wafer-like substrate 1 -- every surface acoustic element 8 -- cutting -- that is, piece[of an individual]-ize.
[0024] (d) Next, as shown in drawing 3 (a), mount a majority of two or more surface acoustic elements 8 in the base substrate 9 of picking through the projection electrode 3 using flip-chip-bonding equipment. By mounting through the projection electrode 3, a surface acoustic element 8 and the base substrate 9 are connected electrically and mechanically through the projection electrode 3. In addition, the base substrate 9 of picking bundles up two or more surface acoustic elements 8, and mounting and in order to carry out a resin seal, two or more base substrates [a majority of] 4 shown in drawing 1 are really formed.
[0025] Two or more surface acoustic elements 1 set predetermined spacing, and are mounted, and the predetermined clearance 10 is formed between the adjoining surface acoustic elements 1.
[0026] (e) Next, as shown in drawing 3 (b), press resin 5 against two or more surface acoustic elements 8 using the mold 12 with which heights 11 were formed corresponding to the clearance 10 between the adjoining surface acoustic elements 8. A metal and other ingredients can be used for the ingredient of a mold 12. Here, explanation is continued about the case where the metal mold 12 which consists of a metal is used. Heights 11 turn the resin 5 of a part without a surface acoustic element 8 to the base substrate 9, and press it. Therefore, a pressure joins the resin 5 on a surface acoustic element 8, and the resin 5 on the base substrate 9 at homogeneity.
[0027] Consequently, sufficient resin also for the clearance 10 between the adjoining surface acoustic elements 8 can enter, and the side face can also be covered and surrounded with resin 5 only on a surface acoustic element 8. Two or more surface acoustic elements 8 can be closed to coincidence with resin 5 through subsequent heat-curing processing. Moreover, the closure height on a surface acoustic element 8 becomes higher than a part without a surface acoustic element 8. That is, as shown in drawing 1 , rather than the top face of the 1st resin section, the top face of the 2nd resin section sees from the base substrate 9, and is set up low.
[0028] (**) Finally, as shown in drawing 3 (c), the surface acoustic wave equipment which showed many base substrates 9 of picking to drawing 1 by resin 5 and piece[of an individual]-izing every surface acoustic element 8 is completed. In addition, it is cut along with the part corresponding to the clearance 10 11 between resin 5 and the surface acoustic element 8 which many base substrates 9 of picking adjoin, i.e., the heights of metal mold 12.
[0029] Drawing 4 (a) is drawing which expanded some process sectional views shown in drawing 3 (b), and shows distribution of arrangement and the configuration of heights 11, and the pressure which joins resin 5. Many base substrates 9 of picking are arranged on the plinth 14. Metal mold 12 has the heights 11 corresponding to a part without a surface acoustic element 8. Arrangement and the configuration of heights 11 are designed so that the upper twist of a surface acoustic element 8 can also press down the part separated from the periphery of a surface acoustic element 8 100 micrometers or more in 10-micrometer or more excess. That is, spacing of a surface acoustic element 8 and heights 11 is 100 micrometers or more, and the height of heights 11 is 10 micrometers or more. The height of heights 11 is about 20 micrometers more desirably.
[0030] The field where many surface acoustic elements 8 are arranged among the component sides of the base substrate 9 of picking has a twice [about] as many area as this to a field without a surface acoustic element 8. When the conventional metal mold which does not have heights 11 is used, the pressures which join resin 5 will differ by the part without a surface acoustic element 8 a surface acoustic element 8 top. However, heights 11 can turn the resin 5 of a part without a surface acoustic element 8 to the base substrate 9, and can press it. Therefore, the pressure which joins the resin 5 of a part without a surface acoustic element 8 can be equalized with the pressure which joins the resin 5 on a surface acoustic element 8. In addition, the magnitude of the arrow head of drawing 4 (a) shows the

magnitude of the pressure which joins resin 5.
[0031] Drawing 4 (b) is the pressure which joins the resin 5 on a surface acoustic element 8 at the time of using the metal mold 12 which has heights 11, the pressure which joins the resin 5 of a part without a surface acoustic element 8, and a graph which shows those time amount change about press ** added between a plinth 14 and metal mold 12. The "chip top face" in drawing 4 (b) shows the pressure which joins the resin 5 on a surface acoustic element 8, "others" shows the pressure which joins the resin 5 of a part without a surface acoustic element 8, and "cylinder pressure" shows press ** added between a plinth 14 and metal mold 12.
[0032] While performing a resin seal, cylinder pressure is regularity (about 60Ns). Cylinder pressure is impressed [almost no] to the resin 5 on the top face of a chip immediately after a resin seal, and it is impressed by the resin 5 of a part without a surface acoustic element 8. After [of resin seal initiation] 5 minutes, the pressure on a surface acoustic element 8 decreases gradually, and the pressure of a part without a surface acoustic element 8 increases. After after [of resin seal initiation] 10 minutes, the pressure on a surface acoustic element 8 and the pressure of a part without a surface acoustic element 8 are reversed, and the pressure of a part without the pressure of 20 Ns and eight surface acoustic element on a surface acoustic element 8 is 40Ns, and is stabilized, respectively.
[0033] Those who used the metal mold 12 which has heights 11 are distributed in comparison with drawing 7 (b) which used the conventional metal mold to the pressure of the part where a surface acoustic element 8 does not have a part of pressure on a surface acoustic element 8. The resin 5 of a part without a surface acoustic element 8 is pressed by sufficient pressure towards the base substrate 9 by this. Consequently, resin 5 can fully enter the clearance between surface acoustic elements, and can prevent generating of the void in the side face of a surface acoustic element 8, and the adhesion between resin 5 and the base substrate 59 can be raised.
[0034] Drawing 5 is drawing which expanded some surface acoustic wave equipments shown in drawing 1 . In drawing 1 , the level difference was formed stair-like between the top face 6 of 1st resin section 5a, and the top face 7 of 2nd resin section 5b. However, in fact, although the top face 6 of 1st resin section 5a is a flat side, the curved surface which inclined to the top face 6 of 1st resin section 5a may be formed in the top face 7 of 2nd resin section 5b.
[0035] When the difference of elevation (t) seen from the base substrate 4 of the top face 7 of 2nd resin section 5b and the top face 6 of 1st resin section 5a in the periphery of the base substrate 4 is set to 1, as for the height (T) seen from the base substrate 4 of the top face 6 of 1st resin section 5a, it is desirable that it is 10 thru/or 15. More desirably, when the difference of elevation (t) is set to 1, the width of face (W) of 2nd resin section 5b is 4 thru/or 20. In addition, the differences of elevation (t) are 50 thru/or 80 micrometers, height (T) is 400 thru/or 500 micrometers, and width of face (W) is 200 thru/or 1600 micrometers. By designing the dimension of the top face (6 7) of the resin section 5 in the above-mentioned numerical range, the resistance to environment of surface acoustic wave equipment improves, and an environmental percent defective decreases. Moreover, fo fluctuation can also be suppressed. This needs to satisfy no conditions, and it can acquire the effectiveness more effectively as the number with which are satisfied of a monograph affair increases.
[0036] As explained above, the impact by the mounter can be reduced by making the closure height on a surface acoustic element 8 higher than a part without a surface acoustic element 8. Moreover, resin 5 sufficient by applying pressure for the resin 5 of a part without a surface acoustic element 8 with sufficient heights 11 also for the clearance between the adjoining surface acoustic elements can enter. By this, it prevents forming a void in the side face of a surface acoustic element 8, and closure dependability improves. Moreover, the fluctuation of fo by closure variation is suppressed to coincidence, and electrical-characteristics dependability improves to it.
[0037] As mentioned above, although the gestalt of one operation indicated this invention, if this invention is limited, he should not understand the statement and the drawing which make a part of this indication. The gestalt, example, and employment technique of various alternative implementation will become clear to this contractor from this indication.
[0038]

[Effect of the Invention] As explained above, according to this invention, the reliable surface acoustic wave equipment and its manufacture approach of resin seal structure can be offered.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the surface acoustic wave equipment concerning the gestalt of operation of this invention.
[Drawing 2] Drawing 2 (a) thru/or (c) are main process sectional views to show the manufacture approach of the surface acoustic wave equipment shown in drawing 1 (the 1).
[Drawing 3] Drawing 3 (a) thru/or (c) are main process sectional views to show the manufacture approach of the surface acoustic wave equipment shown in drawing 1 (the 2).
[Drawing 4] Drawing 4 (a) is drawing which expanded some process sectional views shown in drawing 3 (b), and shows distribution of arrangement and the configuration of heights, and the pressure which joins resin. Drawing 4 (b) is the pressure which joins the resin on a surface acoustic element at the time of using the metal mold which has heights, the pressure which joins the resin of a part without a surface acoustic element, and a graph which shows those time amount change about press ** added between a plinth and metal mold.
[Drawing 5] Drawing 5 is drawing which expanded some surface acoustic wave equipments shown in drawing 1 .
[Drawing 6] Drawing 6 (a) is the process sectional view showing the resin seal process in the manufacture approach of the surface acoustic wave equipment concerning the conventional technique. Drawing 6 (b) is the sectional view showing the surface acoustic wave equipment concerning the conventional technique.
[Drawing 7] Drawing 7 (a) is drawing which expanded some process sectional views shown in drawing 6 (a), and shows distribution of the pressure which joins resin. Drawing 7 (b) is the resin on a surface acoustic element at the time of using the conventional metal mold which does not have heights, the resin of a part without a surface acoustic element, and a graph that shows those time amount change about the pressure added between a plinth and metal mold, respectively.
[Description of Notations]
1 Piezoelectric Substrate
2 Ctenidium Electrode
3 Projection Electrode
4 Base Substrate
5 Resin Section
5a The 1st resin section
5b The 2nd resin section
6 Seven Top face
8 Surface Acoustic Element
9 It is Base Substrate of Picking in Large Numbers.
10 Spacing
11 Heights
12 Metal Mold

[Translation done.]

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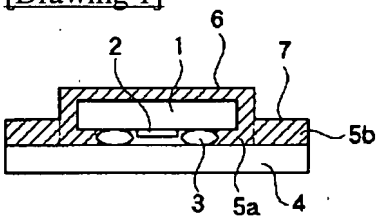
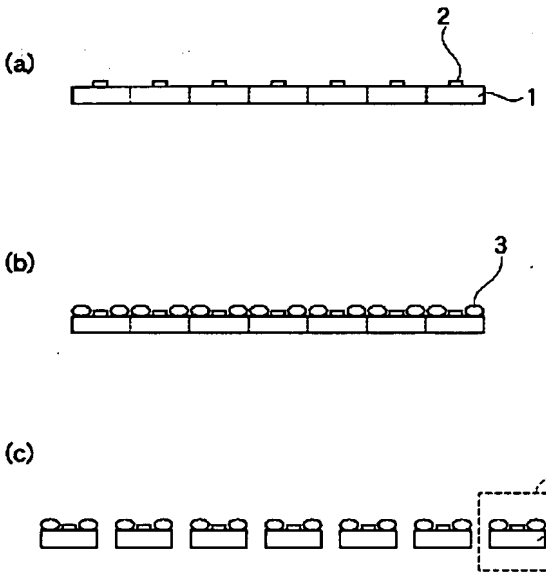
DRAWINGS

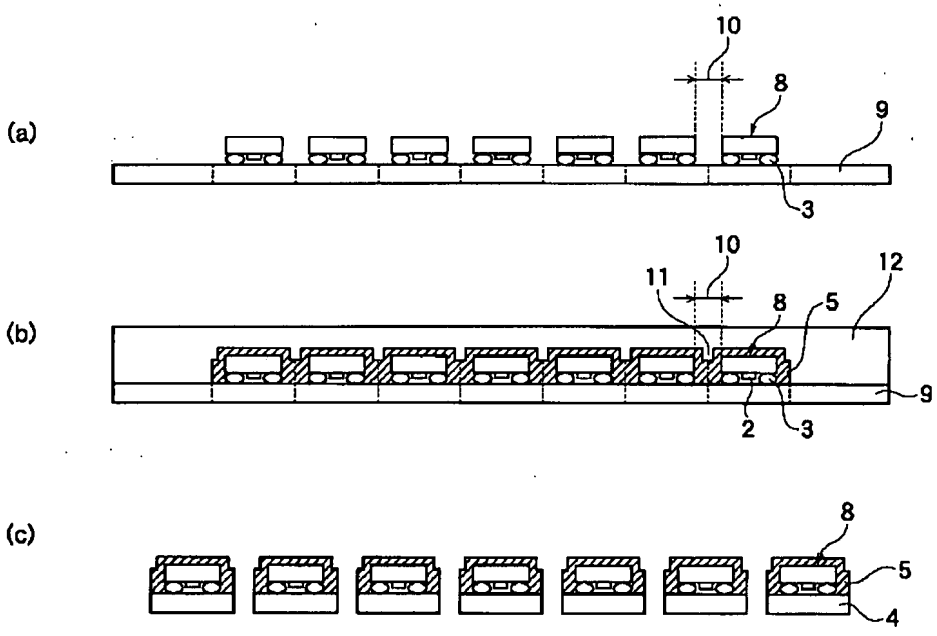
[Drawing 1]



[Drawing 2]



[Drawing 3]



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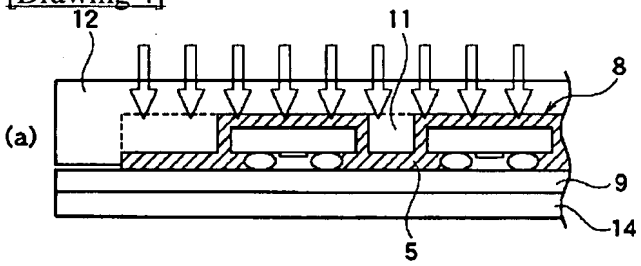

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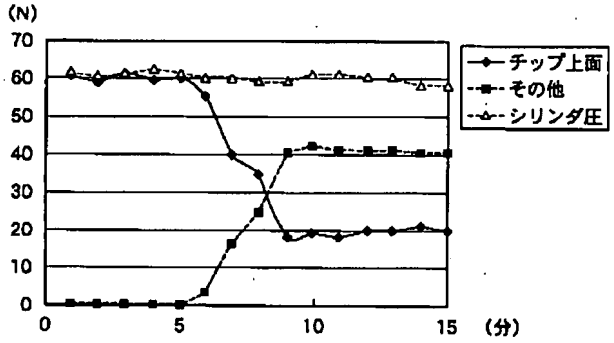

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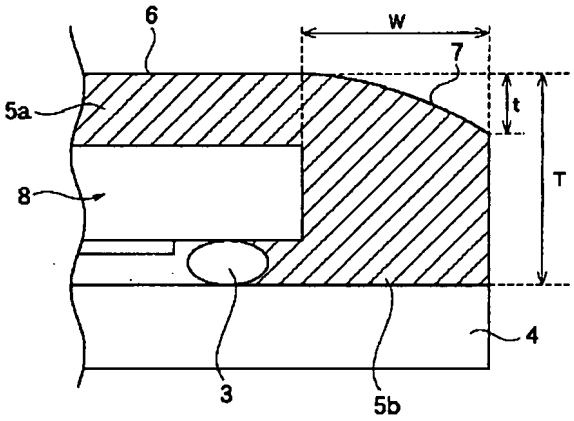
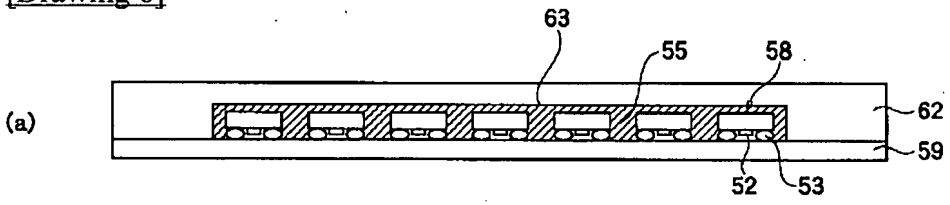
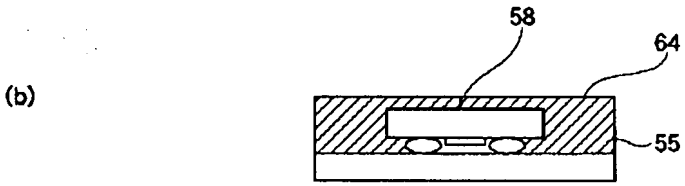
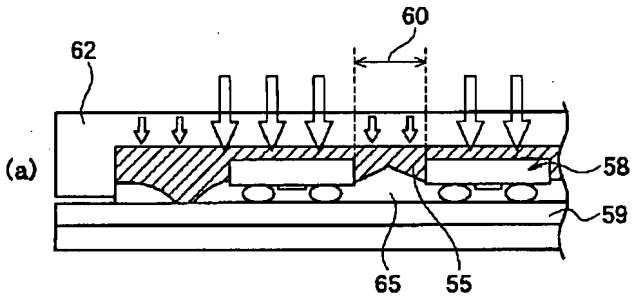


[Drawing 6]





[Drawing 7]



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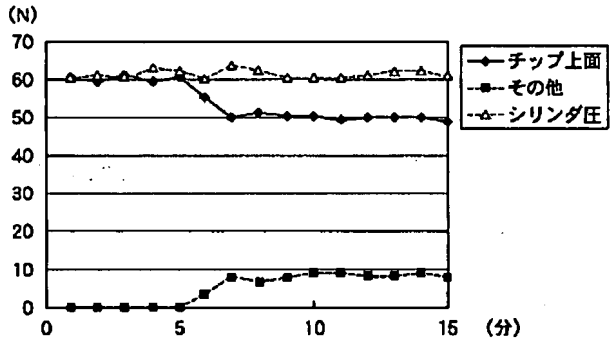

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